FIRST INTERNATIONAL CONFERENCE ON ELECTRON MICROSCOPY OF NANOSTRUCTURES

ELMINA 2018

ПРВА МЕЂУНАРОДНА КОНФЕРЕНЦИЈА О ЕЛЕКТРОНСКОЈ МИКРОСКОПИЈИ НАНОСТРУКТУРА

САНУ

August 27-29, 2018, Belgrade, Serbia
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FIRST INTERNATIONAL CONFERENCE

ELMINA 2018

PROGRAM & BOOK OF ABSTRACTS

Rectorate of the University of Belgrade, Belgrade, Serbia
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Organized by:
Serbian Academy of Sciences and Arts and Faculty of Technology and Metallurgy, University of Belgrade

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FIRST INTERNATIONAL CONFERENCE
ELMINA 2018
Program and Book of Abstracts

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At the beginning we wish you all welcome to Belgrade and ELMINA2018 International Conference organized by the Serbian Academy of Sciences and Arts and the Faculty of Technology and Metallurgy, University of Belgrade. We are delighted to have such a distinguished lineup of plenary speakers who have agreed to accept an invitation from the Serbian Academy of Sciences and Arts to come to the first in a series of electron microscopy conferences: Electron Microscopy of Nanostructures, ELMINA2018. We will consider making it an annual event in Belgrade, due to this year's overwhelming response of invited speakers and young researchers. The scope of ELMINA2018 will be focused on electron microscopy, which provides structural, chemical and electronic information at atomic scale, applied to nanoscience and nanotechnology (physics, chemistry, materials science, earth and life sciences), as well as advances in experimental and theoretical approaches, essential for interpretation of experimental data and research guidance. It will highlight recent progress in instrumentation, imaging and data analysis, large data set handling, as well as time and environment dependent processes. The scientific program contains the following topics:

- Instrumentation and New Methods
- Diffraction and Crystallography
- HRTEM and Electron Holography
- Analytical Microscopy (EDS and EELS)
- Nanoscience and Nanotechnology
- Life Sciences

To put this Conference in proper prospective, we would like to remind you that everything related to nanoscience and nanotechnology started 30 to 40 years ago as a long term objective, and even then it was obvious that transmission electron microscopy (TEM) must play an important role, as it was the only method capable of analyzing objects at the nanometer scale. The reason was very simple - at that time, an electron microscope was the only instrument capable of detecting the location of atoms, making it today possible to control synthesis of objects at the nanoscale with atomic precision. Electron microscopy is also one of the most important drivers of development and innovation in the fields of nanoscience and nanotechnology relevant for many areas of research such as biology, medicine, physics, chemistry, etc. We are very proud that a large number of contributions came from young researchers and students which was one of the most important objectives of ELMINA2018, and which indicates the importance of electron microscopy in various research fields. We are happy to present this book, comprising of the Conference program and abstracts, which will be presented at ELMINA2018 International Conference. We wish you all a wonderful and enjoyable stay in Belgrade.

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TiO_2 Nanoparticle Deposition on Solid CP-Ti Substrate through Spraying Water Colloid in the Arc Plasma

Vladimir Pavkov[1], *Milovan M. Stoiljković*[2], *Vesna M. Maksimović*[1], *Ivana Lj. Cvijović-Alagić*[1], *Jovan Ciganović*[2] *and Mila R. Vranješ*[3]

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Surface modification techniques are an important area of biomaterials research and biomedical engineering of titanium-based materials. Coatings composed of titanium dioxide are stable and non-toxic to the environment or humans. Moreover, titanium dioxide is well known for its antibacterial properties [1]. Different authors have reported that titanium dioxide induces the precipitation of bone-like apatite particles or calcium phosphates on its surface making it a suitable candidate for bone replacement and hard-tissue reconstruction [1, 2]. In most of the biosensing applications, where TiO_2 plays a role of an interface layer, its surface needs to be additionally functionalized in order to achieve selective binding of biological molecules. The functionalization process can be achieved by physical adsorption of a bioreceptor or by its chemical binding. Nowadays, TiO_2 films and coatings can be obtained using a number of well-established vapor or liquid-based deposition techniques [1, 2].

The present study describes an improved method for TiO_2 coating deposition onto the commercially pure (CP) Ti substrate by spraying colloidal solution of TiO_2 nanoparticles in the electric discharge plasma. The success of the proposed deposition method is investigated by characterization of the deposited coating morphology using a scanning electron microscope (SEM) and 3D surface morphology analyzer (*i.e.* optical profilometer).

<u>Aerosol generation</u>: Colloidal water solution of TiO_2 nanoparticles with a concentration of 0.24 M and 10^{17} particles/ml and with agglomeration number of 1402 was

used for spraying [3]. The spray was produced using Meinhard pneumatic nebulizer, Type A, coupled with the Scott-type cloud chamber, Figures 1 and 2. The supporting argon gas flow was 2 dm^3/min and the aerosol yield is about 0.03 ml of liquid per 1dm^3 of argon. According to the nebulizer system used, it can be assumed with high certainty that the most of the aerosol droplets are approximately 10 µm in size. Spraying time was 1 min.

Direct current arc plasma (DCP): Direct current arc discharge was used to generate spatially and temporarily stabilized atmospheric pressure plasma [4]. The argon stream carrying the aerosol enters tangentially to the circular cavity of the arc discharge and forms a vortex around the plasma column, see Figure 1. The arc column, about 2.5 mm in diameter, reaches temperatures ranging from 9000 K in the center of the vortex to 6000 K at the vortex periphery.

CP-Ti workpiece: A ring-shaped CP-Ti workpiece was fixed coaxially inside the circular cavity (see insert in Figure 1). The current carrying plasma channel passes orthogonally through the ring and heats it. Aerosol vortex interacts with the plasma inducing in that way droplets desolvation followed by partial melting of TiO_2 solids and their evaporation. As a result, deposits are formed on the CP-Ti workpiece, Figures 3 and 4.

SEM images presented in Figures 3 and 4 show morphology of the TiO_2 film deposited on the CP-Ti substrate surface at various distances from the plasma center. It could be seen that the size of the TiO_2 particles deposited on the substrate surface increases with the increase of the distance from the center of the workpiece.

Conducted investigations confirmed that stable titanium dioxide layer can be successfully deposited on the CP-Ti surface by applying this simple and cost-effective method. Nevertheless, the described method provided a good dispersion of the titanium dioxide nanoparticles onto the substrate surface enabling in that way the formation of the continuous layer [5].

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[5] The authors acknowledge funding from the Ministry of Education, Science and Technological Development of the Republic of Serbia through the Grants Nos. OI172019, OI174004, OI172056 and III45012.

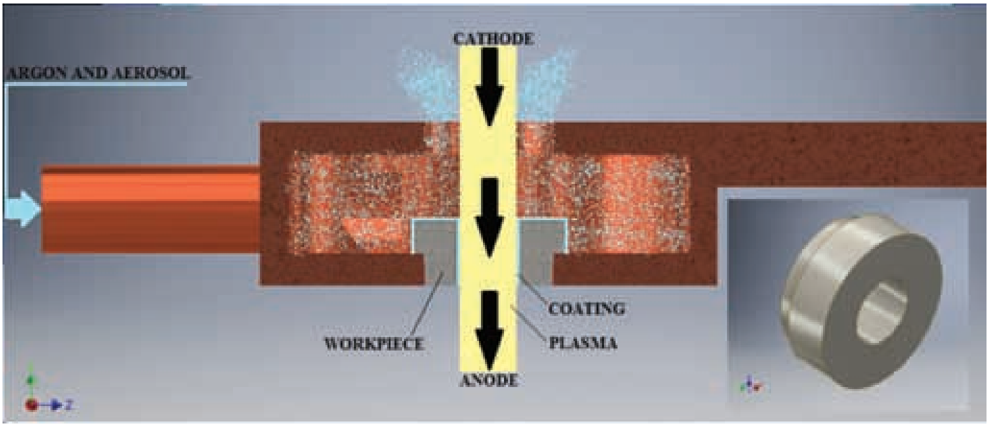

Figure 1. Illustration of the applied set-up. The insert represent illustration of the ring-shaped CP-Ti workpiece.

Figure 2. TEM image of the TiO_2 colloidal nanoparticles.

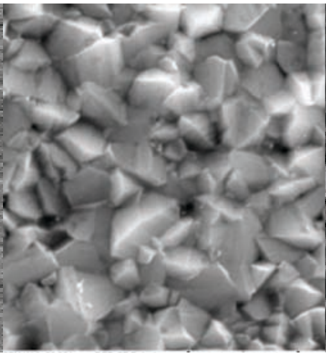

Figure 3. Surface morphology of the TiO_2 deposit close to the outer edge of the workpiece.

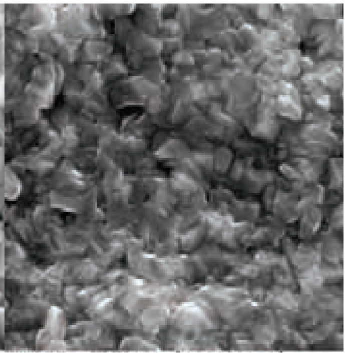

Figure 4. Surface morphology of the TiO_2 deposit close to the inner edge of the workpiece.

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